Steklo i Keramika 1998 N6, pages 263

Specific features of the complexation of copper(II), manganese(II), and gadolinium(III) with salicylic, benzoic, and sulfosalicylic acids in aqueous solutions of nonionic surfactant

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Abstract

The methods of potentiometric titration and NMR relaxation were used to study the influence of the nonionic surfactant (NS), namely Triton X-100 (TX), on the acid-base and complexing properties of salicylic (H2L), benzoic (HR), and sulfosalicylic (H3X) acids. The influence of NS added on the titration curves of the examined acids was analyzed and it was established that salicylic and benzoic acids are bound by micelles to form species {H2L(TX)} and {HR(TX)} with logK equal to 2.12±0.03 and 1.57±0.03, respectively. The acidic properties of H3X are virtually the same in water and in the NS solutions. A significant (more than two-fold) increase in the proton relaxation rate is observed in the solutions of the mixtures of salicylic acid and TX in the presence of Cu2+, Mn2+, or Gd3+ ions. This effect was explained by the formation of ternary cation-ligand-surfactant species. For Cu(II) and Mn(II), compounds {M(HL)2(TX)2} with log K equal to 0.90±0.04 and 1.05±0.04, respectively, were detected. Complexes of composition {Gd(HL)3(TX)2} with logK=0.22±0.05 were discovered for Gd(III). The ternary species of benzoic acid are formed only in the presence of gadolinium: {GdR(TX)} with logK=-2.17±0.04. Sulfosalicylic acid does not form such mixed NS-containing compounds with the cations examined.